

Long-Term Changes in the Perception of Job Characteristics: Results from the Belstress II—Study

Els CLAYS¹, Dirk De BACQUER¹, Francoise LEYNEN², Marcel KORNITZER², France KITTEL² and Guy De BACKER¹

¹Department of Public Health, Ghent University and ²Laboratory of Epidemiology and Health Promotion, School of Public Health, Free University of Brussels, Belgium

Abstract: Long-Term Changes in the Perception of Job Characteristics: Results from the Belstress II—Study: Els CLAYS, *et al.* Department of Public Health, Ghent University, Belgium—The aim was to explore long-term changes in the perception of job characteristics—based on the Job Content Questionnaire (JCQ)—in view of the changing labor market in Western societies. A total number of 2,821 workers from nine companies were involved in the longitudinal Belstress-project. Data were gathered on two occasions with a mean time interval of 6.6 yr. At both times, participants completed the JCQ which measures the perception of job demands, job control and social support. In addition, the instrument contains questions regarding physical job demands, job insecurity and impact of world market competition (WMC). Changes over time in the perception of the different dimensions of the JCQ were evaluated within a sample of 2,490 respondents who remained in the same job. A statistically significant long-term stability of all JCQ scales was found. As far as intra-individual changes over time are concerned, the population showed a modest average increase in the perception of job demands, control and support of approximately 3%. Long-term changes in the other scales were larger, with an average increase of 10.3% in job insecurity and 15.5% in impact of WMC. Substantial variation in these two scales was found at the level of the company and in some socio-demographic factors. While perceived job characteristics remained relatively stable over an average period of 6.6 yr, a substantial increase was noted in job insecurity and the impact of WMC. These dimensions are becoming increasingly important within the context of economic globalization and labor market flexibility.

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For many years, work-related psychosocial factors have been considered to have important implications for health conditions. The perception of stress at work has been extensively studied and related to health outcomes. Many of these studies were situated in the field of cardiovascular health¹, but associations have also been demonstrated with respect to mental health², musculoskeletal disorders³ and sick leave⁴.

One of the most influential and widely used models in this field is the Job Demand-Control (-Support) (JD-CS) model, introduced by Karasek in the seventies^{5, 6}. According to this model, the most adverse health effects are expected when workers are exposed to high psychological demands in combination with low decision latitude or job control, which is labeled as ‘high job strain’. At a later date, the model was extended to a third dimension, social support at the workplace by supervisors and co-workers⁷. The ‘iso-strain’ hypothesis states that people with high strain and low social support, labeled as ‘isolated strain’, are most vulnerable to negative health effects. The Job Content Questionnaire (JCQ), a self-administered instrument, was designed to measure psychosocial job characteristics in a standardized way⁸. The instrument also contains a measure of physical demands of the job, because the ‘demanding’ aspects of work relate to both mental and physical loads. In addition, the instrument was supplemented with items assessing the perception of job security and the impact of world market competition (WMC) on perceptions of demands, control and job security. Validity and reliability of different versions of the JCQ have been demonstrated in several studies^{6, 9–12}. The attractiveness and broad international usage of the instrument is attributed to its

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Correspondence to: E. Clays, Department of Public Health, Ghent University, University Hospital, Block A, De Pintelaan, 185, B-9000 Ghent, Belgium (e-mail: els.clays@UGent.be)

simple use, short length and predictive validity.

This study addressed the issue of long-term changes in the perception of the different dimensions of the JCQ over an average interval of 6.6 yr in people who remained in the same job. The first objective of this study was to find out whether or not there is a statistically significant long-term stability of the JCQ scales. Long-term stability was examined for the three core dimensions of the job strain model—job demands, job control and social support—in addition to the supplementary scales of physical demands of the job, job insecurity and impact of WMC. Our hypothesis was that the job characteristics scales are significantly stable over a 6.6 yr time interval, as in previous studies which have reported the stability of the scales over periods of five years¹³⁾ and four years¹⁴⁾. The second objective was to explore the particular nature and extent of intra-individual changes in job characteristic scales over a period of 6.6 yr on average. In view of increased globalization and flexibility of labor markets in Western societies over the last decade^{15–17)}, it was hypothesized that perceptions of job characteristics would be influenced by these trends. We especially expected the perceptions of job insecurity and the impact of WMC to have increased since these scales were added to the JCQ, in order to respond to the rapidly increasing importance of factors at the organization, especially, global economy level contributing to increased demands, job insecurity and lack of control⁸⁾.

Methods

Study population

Long-term evolutions in the perception of the different dimensions of the JCQ were explored using data from the Belstress-project, a large epidemiological cohort study about job stress, cardiovascular and other health issues and sickness absence. Belstress is the Belgian part of the European JACE study¹⁸⁾. Between 1994 and 1998, a total of 21,419 respondents, aged 35–59 yr, from 25 large companies or public administrations across Belgium were involved in the first phase of the study. Although this population cannot be considered representative of the Belgian workforce, it is fair to assume that the sample contains substantial variation in exposure to job stress.

In 2002–2003, some companies with whom good cooperation had been achieved in the first study phase were selected for participation in Belstress II. Nine of the original 25 companies or public administrations were involved. Within these companies, all persons who had participated in Belstress I and who were still at work, were invited to participate in the second phase. Overall, 52% of the original population was no longer available for participation due to decease, chronic disease, retirement, resignation or dismissal. Within three companies from the secondary or manufacturing sector, major reorganizations and restructuring measures had

been carried out, as a result of which, 73% of the original study sample was no longer at work at the follow-up. Some important reorganizations had also taken place within four companies from the service sector; 47% of the population was no longer eligible for participation. Within two public administrations, 33% was no longer eligible, which was mostly due to natural retirement. A total number of 2,821 participants remained which was 67.2% of the eligible population. In both phases of the study—Time 1 (T1) and Time 2 (T2)—respondents were classified into occupational groups according to the first digit of the International Standard Classification of Occupations¹⁹⁾. Results presented here are based on observations in 2,490 participants who did not change jobs during the interval between T1 and T2. Since the aim of this study was to explore changes in the perception of the work environment, we wanted to rule out changes that were due to objective changes in job title.

The Belstress study was approved by the ethics committees of the University Hospitals of Ghent (UZ) and Brussels (Erasmus).

Job characteristics scales

In both phases of the study, participants completed a self-administered questionnaire containing the recommended version of the JCQ⁸⁾. Psychological job demands were measured by five items that relate to mental work load, organization constraints on task completion and conflicting demands. Job control or decision latitude was composed of two subscales: 'skill discretion', or the level of skill and creativity required on the job (six items), and 'decision authority', or the possibilities for workers to make decisions about their work (three items). The dimension of social support at the workplace also consisted of two subscales: 'supervisor support' (four items) and 'co-worker support' (four items). In case of one missing value per (sub)scale concerning the dimensions of demands, control and support, the mean value which was calculated over the set of remaining valid (sub)scale-items for that particular respondent was imputed, picking up 5% more valid cases at most.

Beside the three core dimensions of the job strain model, the JCQ instrument contains some additional scales⁸⁾. The scale of physical demands contained five items on physical exertion, static and dynamic physical loads. Perception of job insecurity was measured with two questions, evaluating the respondent's assessment of his or her present and future situation regarding job security. Impact of WMC was measured by three items that relate to the threat or the impact of competition from world trade on the respondent's perception of job security, work pace and influence over the way things are organized at the workplace.

All JCQ items have four response categories ranging from 'fully agree' to 'fully disagree', except for the item

Table 1. Basic characteristics of the job characteristics scales (N=2,490)

	Number of items	T1			T2		
		Mean (SD)	Range	Cronbach alpha	Mean (SD)	Range	Cronbach alpha
Psychological job demands	5	30.5 (6.4)	12–48	0.73	30.6 (6.1)	12–48	0.71
Job control	9	68.3 (12.0)	26–96	0.82	69.2 (11.4)	24–96	0.81
Social support at work	8	22.6 (3.7)	8–32	0.84	22.9 (3.5)	8–32	0.82
Physical job demands	5	9.5 (3.4)	5–20	0.87	9.5 (3.3)	5–20	0.85
Job insecurity	2	3.4 (1.3)	2–8	0.70	3.5 (1.4)	2–8	0.70
Impact of WMC	3	6.0 (2.5)	3–12	0.89	6.4 (2.4)	3–12	0.87

WMC=world market competition.

Table 2. Changes over time in the perception of the job characteristics scales (N=2,490)

	Spearman cross-time correlation	% in same category– [kappa coefficient]	Mean difference T2–T1	Mean% change (SD)	CI mean% change
Psychological job demands	0.50***	68–[0.36]	0.10	2.8 (22.5)	(1.9; 3.7)
Job control	0.60***	74–[0.47]	0.87 ^a	3.0 (18.3)	(2.3; 3.8)
Social support at work	0.38***	65–[0.29]	0.36 ^a	3.7 (20.5)	(2.9; 4.5)
Physical job demands	0.72***	79–[0.57]	0.03	4.3 (29.0)	(3.2; 5.5)
Job insecurity	0.48***	70–[0.39]	0.11 ^a	10.3 (46.3)	(8.5; 12.1)
Impact of WMC	0.67***	79–[0.57]	0.39 ^a	15.5 (46.1)	(13.7; 17.3)

CI=95% Confidence Interval; WMC=world market competition; ***= $p < .001$; ^a=Paired-Samples t test $p < .001$.

concerning future job insecurity which has outcome categories ranging from ‘very unlikely’ to ‘very likely’.

Statistical analyses

Cross-time stability in the perception of the different JCQ scales was assessed with non-parametric Spearman rank correlation coefficients, which are based on the ranking of data. Kappa coefficients were calculated as a measure of agreement between classification at T1 and T2 into high and low levels of the JCQ scales. For the purpose of examining the nature and extent of changes over time in the perception of job characteristics, differences between the scores at the first and second data collection were computed. Whether the average differences were significantly different from zero were tested by means of Paired-Samples t tests. Besides the differences in absolute values, proportional changes in the scores were calculated $[(T2 - T1) / T1 * 100]$. General distributions of these percentage evolutions were considered, with the Komogorov-Smirnov test to assess normality. In analyses of variance, mean percentage changes in the scores were compared between categories of gender, age, educational level, occupational class and company. In case of more than two categories, Scheffé post hoc tests were conducted in order to make pairwise

comparisons of the factor level means.

All statistical analyses were performed using SPSS 10.0 software.

Results

Perceptions of the JCQ dimensions were measured on two occasions in a sample of 2,490 workers with stable job titles. The time interval between the first and second phase of the study ranged from four to eight years; the mean interval was 6.6 yr (SD 1.13). The majority of the population (67%) was male. The sample contained 17.2% executives, 47.1% white-collars and 35.7% blue-collar workers. Participants were aged 40–64 yr at the second phase; the mean age was 50 yr (SD 4.88).

Table 1 shows basic characteristics of the JCQ scales. Internal consistency of the scales at both times of data-gathering was good or acceptable, with Cronbach’s alpha’s ranging from 0.70 to 0.89.

The extent of changes over time in the perception of the JCQ dimensions is shown in Table 2. Cross-time correlations were highly significant for all scales, although substantial differences exist in the strength of correlation. High correlation between the two measurements was found in the scales of physical job demands and impact of WMC, while the scale of social

Table 3. Changes in the perception of job characteristics' scales in relation to socio-demographic and environmental factors (N=2,490)

	% changes											
	Psychological job demands		Job control		Social support at work		Physical job demands		Job insecurity		Impact of WMC	
	Mean	<i>p</i> ^a	Mean	<i>p</i> ^a	Mean	<i>p</i> ^a	Mean	<i>p</i> ^a	Mean	<i>p</i> ^a	Mean	<i>p</i> ^a
Gender		0.03		0.29		0.02		0.38		0.00		0.63
Men	2.0		2.8		4.1		4.1		16.1		15.8	
Women	4.6		3.5		2.6		4.9		-1.8		14.9	
Age		0.12		0.08		0.71		0.50		0.00		0.25
40-49	3.2		4.0		3.7		4.8		11.2		16.3	
50-64	2.5		2.2		3.6		4.0		9.5		14.9	
Educational level		0.99		0.94		0.30		0.47		0.02		0.99
Higher	0.9		1.8		3.1		5.6		16.1		10.5	
Middle	3.2		3.5		5.0		3.6		4.5	b	15.0	
Lower	4.0		3.6		3.1		3.9		10.7		20.1	
Occupation		0.51		0.10		0.06		0.21		0.29		0.00
Executives	-0.5		0.2		2.2		4.9		19.3		9.0	
White-collars	2.7		3.7		4.7		5.3		4.7		12.4	
Blue-collars	4.6		3.5		3.0		2.8		13.4		23.3	b

WMC=world market competition; ^a=Multivariate: adjusted for other factors in the table and additionally for company; ^b=*p*<.001 (results Scheffé Post Hoc tests: significance of difference from first category).

support at the workplace had a weak cross-time correlation.

At both observation times participants were classified into high and low levels regarding the six JCQ dimensions, based on the median-split procedure. When considering the proportion of participants staying in the same category (high or low) at T2 as compared to T1, a similar pattern regarding long-term changes emerged: the percentage staying in the same category and the corresponding kappa coefficient were high with respect to the impact of WMC, physical demands of the job and job control, while the Kappa coefficient was only moderate with respect to social support, job demands and job insecurity.

In order to explore the extent and nature of long-term changes in the perception of job characteristics in more detail, Paired-Samples *t* tests were conducted and percentage changes in the JCQ scales were calculated. Scores in all six scales increased on average but without statistically significance for psychological and physical demands of the job. Long-term proportional changes in the three core scales of the job strain model—demands, control and support—as well as in physical job demands, followed a fairly regular and uniform pattern. The percentage changes were not excessively large and according to Komogorov-Smirnov tests a more or less normal distribution was approached. On average, the population showed a modest increase in the scores of

approximately 3%. This rather normal and regular distribution of evolutions was especially true for the job control scale. In contrast, the patterns of long-term evolutions in perception of job insecurity and WMC were rather irregular; they were less normally distributed and showed more excessive changes. On average, the sample was characterized by a substantial increase in job insecurity (10.3%) and impact of WMC (15.5%).

We also examined whether changes in the perception of the JCQ dimensions differ in relation to socio-demographic and environmental factors (Table 3). Apart from physical job demands, there was significant variation in the long-term changes of the scales between the different companies, irrespective of age, gender, educational level and job title. This difference at the company level was most manifest with respect to changes in job insecurity and the impact of WMC.

The percentage increase of the six job characteristics scales was rather homogeneous across age and educational level (with the exception of job insecurity), and occupation (with the exception of impact of WMC). Gender differences were more pronounced with less increase of psychological job demands in men and less increase of social support in women, who showed a slight decrease in perception of job insecurity.

For the analyses presented here, workers whose job title changed between T1 and T2 were excluded. In Table 4, mean JCQ scores at baseline are compared between

Table 4. Comparison of job characteristics scales at baseline between workers who stayed in the same job (N=2,490) and workers whose job title changed (N=331)

	N=2,490 Mean (SD)	N=331 Mean (SD)	<i>p</i> ^a
Psychological job demands	30.5 (6.4)	32.2 (6.7)	0.00
Job control	68.3 (12.0)	70.4 (12.2)	0.28
Social support at work	22.6 (3.7)	22.6 (3.3)	0.83
Physical job demands	9.5 (3.4)	9.2 (3.5)	0.99
Job insecurity	3.4 (1.3)	3.5 (1.3)	0.29
Impact of WMC	6.0 (2.5)	6.5 (2.5)	0.12

WMC=world market competition; ^a=adjusted for age, gender and educational level.

workers who stayed in the same job (2,490 participants) and workers whose job title changed from T1 to T2 (331 participants). The subgroup with job changes showed significantly higher mean job demands scores, independent of age, gender and educational level. When long-term changes in JCQ dimensions were explored within this subgroup with changing jobs, a distinct pattern emerged (results not shown in table). Cross-time correlations for all JCQ scales were still statistically significant, but Spearman correlation coefficients were somewhat weaker with respect to psychological job demands (0.45), job control (0.58), social support at work (0.34) and physical job demands (0.67). An important difference was found regarding the long-term change in physical job demands: no slight increase was established in those whose job title changed (the average increase was only 0.5%, SD 29.1); moreover, a statistically significant mean difference in T2–T1 scores of –0.47 was found according to the Paired-Samples *t* test ($p < 0.01$). Also notable is the distinct pattern for change in job control perception: a larger average increase of 5.2% (SD 21.4) was found within the subgroup with changing job title, as well as a higher mean difference in T2–T1 scores of 2.26 ($p < 0.001$). In addition, those whose job title changed had a smaller average increase in psychological job demands of 1.7% (SD 26.0) and a somewhat larger average increase in social support at work of 5.0% (SD 18.9).

Discussion

Main findings

The aim of this study was to explore long-term changes in the perception of the different dimensions of the JCQ over an average interval of 6.6 yr, in a population of 2,490 participants who remained in the same job. A statistically significant long-term stability of all JCQ scales was found. As far as the nature and extent of intra-individual changes over time is concerned, the perception of psychological and physical job demands, job control and social support remained relatively stable over the average period of 6.6

yr, while a substantial increase was noted in feelings of job insecurity and impact of WMC.

Several studies have highlighted the importance of assessing cumulative working life exposure to job stress rather than measuring job characteristics at only one point in time, since this reduces the risk of misclassifications due to inaccuracy in assessments^{20–25}. In some studies, short-term stability of job characteristics scales has been demonstrated with cross-time (one year) correlation coefficients for job demands ranging from 0.64 to 0.68, and for decision latitude ranging from 0.64 to 0.76^{10, 26, 27}. Cross-time correlation coefficients in our population are lower compared to these, but are still highly significant. Stability over time was clearly highest when it concerns perceptions of rather objective aspects of the workplace, such as physical load and globalization in the organization. Overall, our findings regarding the long-term stability of job characteristics scales are comparable to the results of two other studies. A statistically significant five-year stability of job characteristics scale scores was shown in a population of 458 Japanese community workers, with moderate intraclass correlation coefficients for the decision latitude scores (0.63) and the job demands scores (0.55)¹³. Similar findings were also reported within an American cohort study including 21,290 female nurses: correlation coefficients over a four year period were 0.60 for job control, 0.54 for job demands and 0.41 for social support¹⁴. In addition, in developing a Work History Questionnaire, Landsbergis *et al.* discovered that retrospective assessment of job demands and job decision latitude using scales with a limited number of items had a moderate correlation with longer JCQ scales when assessing the same job at later dates, while the assessment of workplace social support was more weakly correlated with the JCQ scales²⁴. These studies however provided no, or only little, information on the exact nature and extent of long-term changes in the perception of job characteristics as measured by the JCQ, especially with respect to the supplementary scales regarding job insecurity and the impact of WMC.

Within our population, a modest average increase in the perception of psychological and physical job demands, job control and social support at work of approximately 3% was noticeable. The percentage changes in these scales, and most of all in job control, were not excessive and approached more or less a normal distribution. On the whole, these results are in line with findings from the Third European Survey on Working Conditions in 2000: between 1995 and 2000, a relative stabilization was found for job control and support from colleagues, as well as a minor intensification of work and a slight deterioration in physical demands²⁸⁾. The core JCQ scales showed some notable responsiveness to change since the cross-time correlation coefficients were weaker for those whose job title had changed at the follow-up. Also, a distinct pattern of intra-individual changes in these scales was found in the subgroup, with a smaller average percentage increase in psychological and physical job demands, and a larger average percentage increase in job control and social support at work. Weaker correlations between baseline and follow-up scores of psychological job demands and job control among workers who experienced job changes, as well as a notable increase in job control levels in this group, were also found in the Japanese five-year follow-up study¹³⁾.

Long-term evolutions in the perception of job insecurity and the impact of WMC followed a rather irregular pattern with more excessive changes. The sample was characterized by a substantial mean increase in job insecurity of 10% and in the impact of WMC of 15.5%. Karasek added these two scales to the JCQ instrument because of the rapidly increasing importance of factors at the organization and, especially, global economy level⁸⁾. Over the last decade, the labor market in Western societies has indeed undergone profound changes characterized by globalization of economic relations, increased flexibility of the job market, an increasing number of precarious jobs and high levels of job insecurity¹⁵⁻¹⁷⁾. These trends are reflected in our results: although perceptions of job characteristics only changed in minor ways over an average period of 6.6 yr, changes in perceptions regarding factors at organizational and global economic levels were less uniform and more pronounced.

Most likely the observed changes in the perceptions were not attributable to the ageing of the participants, since no cross-sectional associations were found between age and the different JCQ scales in our population. One exception to this however is the perception of job insecurity, which was negatively related to age. Therefore the observed increase in the perception of job insecurity was probably underestimated.

We found considerable variation in the long-term changes in perception of job characteristics at the level of the companies. Several studies have shown

associations between the organizational context and level of stability on the one hand and the perception of psychosocial job characteristics and job insecurity on the other^{29, 30)}. A notable gender difference was found in relation to the perception of job insecurity, with an average increase of 16% for men, while the situation for women was better at almost 2%. Although the difference was independent of educational level or occupational class, it could be that even within the same occupational class, men are more likely to be employed in rather unstable jobs with higher risk of discharge, while women prefer rather low-profile jobs with more stability and security. It has been suggested that the experience of unemployment and job insecurity is more problematic for men because they perceive work as their core role in society, while women are protected by their alternative role in taking care of the household and children³¹⁾. This could also explain why men and women perceive their situation of job insecurity in different ways, even though they are facing the same changes in the labor market.

Limitations of the study

The main limitation of this study is that the results are not based on a random sample of the working population, as a result of which our findings cannot be generalized to all workers in Belgium. However, the population contains substantial variation in companies and occupational groups. The selection of nine companies at T2 was mainly based on practical grounds. Since, however, no considerable differences in socio-demographic factors or perception of job characteristics at baseline were observed compared with the non-selected companies, it is fair to assume that this selection does not significantly bias our results. Within the nine companies involved, all prior participants of Belstress I were invited to participate in the second phase of the study. More than half of the original population in these companies was no longer eligible due to retirement, resignation, dismissal, chronic disease or decease. Some companies had undergone major reorganizations with subsequent discharges as a result of which the population of possible participants had been reduced considerably. Obviously this results in a survivor-bias within our population. When comparing the study sample with the 'drop-out' population, a healthy-worker effect indeed becomes visible. At baseline, the 'drop-out' population perceived significantly less job control, more job insecurity and more impact of WMC. Consequently, it is likely that the increases we observed in feelings of job insecurity and the impact of WMC were underestimated. Of the eligible workers, 67.2% actually participated in the study. The non-respondents were on average older and lower educated, which might have influenced our results.

In exploring the dynamics in the perception of the JCQ scales, 331 participants who changed job category

between T1 and T2 were excluded from the analyses. This was done in order to rule out changes in perception that were due to objective changes in job title. Evidently this does not mean that we have excluded all possible objective job changes. First, only those whose job title changed according to the first digit of the International Standard Classification of Occupations were excluded. Also, no information on changes of job contents within the same job title was available. In particular, workers often gain skills or get promoted with time and age. Therefore, it cannot be excluded that the modest average increase in perceived job control within the study sample is related to this natural process.

Implications and future research

The Belstress II study was set up mainly to explore long-term dynamics in job stress perception in relation to health outcomes. Based on our results, perceptions of job characteristics appear to be relatively stable over time, which is of importance for work-related health research. A few studies have shown that health effects are more harmful when exposure to job stress is cumulative^{23, 32}.

Our results regarding the increase in job insecurity and impact of WMC have serious implications for public health. Several studies have pointed out that job insecurity and precarious employment have adverse effects on psychological well-being and health status^{31, 33–38}. Additionally it is suggested that high levels of job insecurity have negative implications for the organizational effectiveness due to a decline in employees' commitment and job performance³⁹. Based on these findings, we recommend that job stress studies should not only take job characteristics like demands and control into account, but additionally focus on job insecurity and impact of WMC. Within the context of the changing labor market, these dimensions are becoming increasingly important. Moreover, it is suggested that the adverse effects of job insecurity are largely independent of other psychosocial job characteristics^{40, 41}.

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References

- 1) Belkic K, Landsbergis P, Schnall P and Baker D: Is job strain a major source of cardiovascular disease risk? *Scand J Work Environ Health* 30, 85–128 (2004)
- 2) Van Der Doef M and Maes S: The job demand-control(-support) model and psychological well-being: a review of 20 years of empirical research. *Work Stress* 13, 87–114 (1999)
- 3) Hoogendoorn W, van Poppel M, Bongers P, Koes B and Bouter L: Systematic review of psychosocial factors at work and private life as risk factors for back pain. *Spine* 25, 2114–2125 (2000)
- 4) Moreau M, Valente F, Mak R, Pelfrene E, de Smet P, De Backer G and Kornitzer M: Occupational stress and incidence of sick leave in the Belgian workforce: the belstress study. *J Epidemiol Community Health* 58, 507–516 (2004)
- 5) Karasek R: Job demands, job decision latitude, and mental strain: implications for job redesign. *Adm Sci Q* 24, 285–309 (1979)
- 6) Karasek R, Brisson C, Kawakami N, Houtman I, Bongers P and Amick B: The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. *J Occup Health Psychol* 3, 322–355 (1998)
- 7) Johnson J and Hall E: Job strain, work place social support, and cardiovascular-disease—a cross-sectional study of a random sample of the Swedish working population. *Am J Public Health* 78, 1336–1342 (1988)
- 8) Karasek R. *Job Content Instrument: Questionnaire and User's Guide*. Los Angeles: University of Southern California, 1985.
- 9) Kawakami N, Kobayashi F, Araki S, Haratani T and Furui H: Assessment of job stress dimensions based on the job demands-control model of employees of telecommunication and electric power companies in Japan: reliability and validity of the Japanese version of the job content questionnaire. *Int J Behav Med* 2, 358–375 (1995)
- 10) Brisson C, Blanchette C, Guimont C, Dion G, Moisan J, Vezina M, Dagenais G and Masse L: Reliability and validity of the French version of the 18-item karasek job content questionnaire. *Work Stress* 12, 322–326 (1998)
- 11) Pelfrene E, Vlerick P, Mak R, de Smet P, De Backer G and Kornitzer M: Scale reliability and validity of the Karasek 'job-demand-control-support' model in the belstress-study. *Work Stress* 15, 297–313 (2001)
- 12) Niedhammer I: Psychometric properties of the French version of the Karasek job content questionnaire: a study of the scales of decision latitude, psychological demands, social support, and physical demands in the GAZEL cohort. *Int Arch Occup Environ Health* 75, 129–144 (2002)
- 13) Kayaba K, Tsutsumi A, Gotoh T, Ishikawa S and Miura Y: Five-year stability of job characteristics scale scores among a Japanese working population. *J Epidemiol* 15, 228–234 (2005)
- 14) Cheng Y, Kawachi I, Coakley E, Schwartz J and Colditz G: Association between psychosocial work characteristics and health functioning in American women: prospective study. *BMJ* 320, 1432–1436 (2000)
- 15) Marmot M. Job insecurity in a broader social and health context. In: Ferrie J, Marmot M, Griffiths J, Ziglio E, eds. *Labour market changes and job insecurity: a challenge for social welfare and health promotion*. Copenhagen: WHO Regional Publications, 1999: 1–9.
- 16) Benach J, Benavides F, Platt S, Diez-Roux A and Muntaner C: The health-damaging potential of new

- types of flexible employment: a challenge for public health researchers. *Am J Public Health* 90, 1316–1317 (2000)
- 17) Goudswaard A, Andries F. European Foundation for the Improvement of Living and Working Conditions. Employment status and working conditions. (Third European Survey on Working Conditions). Luxembourg: Office for Official Publications of the European Communities, 2000.
 - 18) Houtman I, Kornitzer M, de Smet P, Koyuncu R, De Backer G, Pelfrene E, Romon M, Boulenguez C, Ferrario M, Origgi G, Sans S, Perez I, Wilhelmsen L, Rosengren A, Olofsson S and Östergren P-O: Job stress, absenteeism and coronary heart disease European cooperative study (the JACE study): design of a multicentre prospective study. *Eur J Public Health* 9, 52–57 (1999)
 - 19) ILO. International Standard Classification of Occupations: ISCO-88. Geneva: International Labour Office, 1990.
 - 20) Johnson J and Stewart W: Measuring work organization exposure over the life course with a job-exposure matrix. *Scand J Work Environ Health* 19, 21–28 (1993)
 - 21) Johnson J, Stewart W, Hall E, Fredlund P and Theorell T: Long-term psychosocial work environment and cardiovascular mortality among Swedish men. *Am J Public Health* 86, 324–331 (1996)
 - 22) Amick B, McDonough P, Chang H, Rogers W, Pieper C and Duncan G: Relationship between all-cause mortality and cumulative working life course psychosocial and physical exposures in the United States labor market from 1968 to 1992. *Psychosom Med* 64, 370–381 (2002)
 - 23) de Lange A, Taris T, Kompier M, Houtman I and Bongers P: Effects of stable and changing demand-control histories on worker health. *Scand J Work Environ Health* 28, 94–108 (2002)
 - 24) Landsbergis P, Schnall P, Pickering T and Schwartz J: Validity and reliability of a work history questionnaire derived from the job content questionnaire. *J Occup Environ Med* 44, 1037–1047 (2002)
 - 25) Landsbergis P, Schnall P, Pickering T, Warren K and Schwartz J: Life-course exposure to job strain and ambulatory blood pressure in men. *Am J Epidemiol* 157, 998–1006 (2003)
 - 26) Carayon P: A longitudinal test of Karasek's job strain model among office workers. *Work Stress* 7, 299–314 (1993)
 - 27) Landsbergis P, Theorell T, Schwartz J, Greiner B and Krause N: Measurement of psychosocial workplace exposure variables. *Occup Med-State Art Rev* 15, 163–188 (2000)
 - 28) Paoli P, Merllié D. European foundation for the improvement of living and working conditions (Third European Survey on Working Conditions). Luxembourg: Office for Official Publications of the European Communities, 2000.
 - 29) Härenstam A, Rydbeck A, Johansson K, Karlqvist M, Wiklund P. Work life and organizational changes and how they are perceived by the employees. In: Isaksson K, Hogstedt C, Eriksson C, Theorell T, eds. *Health effects of the new labour market*. New York: Kluwer Academic / Plenum Publishers, 2000: 105–117.
 - 30) Westerlund H, Theorell T and Alfredsson L: Organizational instability and cardiovascular risk factors in white-collar employees—an analysis of correlates of structural instability of workplace organization on risk factors for coronary heart disease in a sample of 3,904 white collar employees in the Stockholm region. *Eur J Public Health* 14, 37–42 (2004)
 - 31) De Witte H: Job insecurity and psychological well-being: review of the literature and exploration of some unresolved issues. *Eur J Work Organ Psychol* 8, 155–177 (1999)
 - 32) Schnall P, Schwartz J, Landsbergis P, Warren K and Pickering T: A longitudinal study of job strain and ambulatory blood pressure: results from a three-year follow-up. *Psychosom Med* 60, 697–706 (1998)
 - 33) Ferrie J, Shipley M, Marmot M, Stansfeld S and Smith G: The health effects of major organisational change and job insecurity. *Soc Sci Med* 46, 243–254 (1998)
 - 34) Ferrie J. Health consequences of job insecurity. In: Ferrie J, Marmot M, Griffith J, Ziglio E, eds. *Labour market changes and job insecurity: a challenge for social welfare and health promotion*. Copenhagen: WHO Regional Publications, 1999: 59–99.
 - 35) Benavides F, Benach J, Diez-Roux A and Roman C: How do types of employment relate to health indicators? Findings from the second European survey on working conditions. *J Epidemiol Community Health* 54, 494–501 (2000)
 - 36) Ferrie J, Shipley M, Stansfeld S and Marmot M: Effects of chronic job insecurity and change in job security on self reported health, minor psychiatric morbidity, physiological measures, and health related behaviours in British civil servants: the whitehall II study. *J Epidemiol Community Health* 56, 450–454 (2002)
 - 37) Pelfrene E, Vlerick P, Moreau M, Mak R, Kornitzer M and De Backer G: Perceptions of job insecurity and the impact of world market competition as health risks: results from belstress. *J Occup Organ Psychol* 76, 411–425 (2003)
 - 38) Lee S, Colditz G, Berkman L and Kawachi I: Prospective study of job insecurity and coronary heart disease in US women. *Ann Epidemiol* 14, 24–30 (2004)
 - 39) Hartley J. Models of job insecurity and coping strategies of organizations. In: Ferrie J, Marmot M, Griffiths J, Ziglio E, eds. *Labour market changes and job insecurity: a challenge for social welfare and health promotion*. Copenhagen: WHO Regional Publications, 1999: 127–149.
 - 40) Ferrie J, Shipley M, Martikainen P, Marmot M and Stansfeld S: Job insecurity in white-collar workers: toward an explanation of associations with health. *J Occup Health Psychol* 6, 26–42 (2001)
 - 41) Souza R, Strazdins L, Lim L, Broom D and Rodgers B: Work and health in a contemporary society: demands, control, and insecurity. *J Epidemiol Community Health* 57, 849–854 (2003)